APPLICATION FOR PATENT

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Title: **Method, system and device for using a regular telephone as a computer audio input/output device.**

CROSS REFERENCE TO PRIOR APPLICATIONS

This application claims priority from US Provisional Application No. 60/200,882 filed May 1, 2000.

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a method, system and device for using a regular telephone as an input/output peripheral device to a computer such as a PC, in addition to its regular telephony functions. Specifically, a regular telephone can be connected through an adapter that does not convert analog to digital (A/D) or D to A signals, directly to the analog input/output ports of a computer, more specifically replacing the microphone and speakers normally connected to the computer. Various configurations of telephones connected to computers for purposes of Internet, Intranet or data network telephony are known, as described for example in US Patent No. 5,838,665 to Kahn, or in WIPO Application No. WO9839897A1 by Shahar. However, these configurations normally require either special telephones, as in Kahn's patent, or A/D adapters and other peripheral connection or conversion elements, all of which add to the cost and cumbersomeness of the combined telephone-computer system.

Voice-over IP clients that are implemented in software, for example VocalTec Internet Phone or MS NetMeeting, use the computer audio peripherals in order to input voice into the software phone, and output voice to the user. The user usually employs a standard microphone and speakers that are attached to the computer. These computer audio peripherals have several problems, such as low audio quality and lack of privacy: low audio quality - because of the microphone quality and the feedback between the microphone and the speakers, echo is added to the voice stream, further reducing the audio quality; and privacy - telephone users are used to talk in relative privacy over the phone handset. The microphone and speakers do not supply this privacy. The prior art solutions suggested in this regard are either expensive or of inferior quality, or both. Thus, typical solutions such as headsets or headset + microphone assemblies tend to be expensive, lower quality ones normally costing over $20, with better quality coming at an increasing price.

There is thus a recognized need for, and it would be highly advantageous to have, a method and system that uses regular telephones as audio input/output devices for computers in addition to their regular functions, without the need of intermediate A/D converters. There is also a recognized need for a simple, high quality, inexpensive method and system for inputting/outputting audio data to a computer. Moreover, there is a recognized need for having a simple, high quality and inexpensive device that allows such input/output to be carried out.

SUMMARY OF THE INVENTION

According to the present invention there is provided a method for inputting/outputting audio data to or from a computer via at least one regular

telephone. the method comprising: a) electrically connecting a configurable adapter between the at least one telephone and the computer; and b) facilitating analog data transfer through the adapter between the at least one telephone and the computer.

According to the present invention there is provided a system for audio data input/output to a computer, comprising: a) at least one telephone, and b) a configurable adapter connected between, and in analog communication with, the at least one telephone and the computer.

According to the present invention there is provided an adapter that facilitates data communication between at least one regular telephone and a computer, while allowing various connections to audio peripherals, comprising: a) electrical connection means to the at least one telephone and the computer; and b) switching means to change operation modes by which the data communication is carried out.

The present invention successfully addresses the shortcomings of the presently known configurations by providing a high quality, low cost computer audio input/output method and system, through the use of a regular telephone, and without A/D conversion between the telephone and the computer.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of a basic embodiment of the system of the present invention.

FIG. 2 is a schematic diagram of a basic embodiment of the adapter of the present invention.

FIG. 3 is a schematic diagram of an embodiment of the system in which commands are transferred between telephone and computer via audio cables.

FIG. 4 is a schematic diagram of an embodiment of the system in which commands are transferred between telephone and computer via another digital port of the computer.

FIG. 5 is schematic diagram showing the connection of the PSTN line also to the computer as an in/out device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a method and system for using a telephone as an input/output peripheral device to a computer, in addition to its regular telephony functions Preferably, the telephone is a regular telephone. Specifically, the invention describes a "non analog to digital (A/D)" configurable adapter, which connects directly a regular telephone to the analog input/output ports of a computer, the telephone thus replacing the microphone and speakers normally connected to the computer. The "non A/D" adapter thus enables the use of a regular telephone as an audio computer device connected directly to the sound card of the computer, replacing the common speakers and microphone. The disclosure will refer hereafter mainly to this adapter, its functions, its connection modes and states, etc. under the generic name of "PhoneConnect". A regular telephone connected through the PhoneConnect adapter to a computer can, for example: 1) place or receive Internet calls; 2) send and receive voice messages such as VoiceMail; 3) have its keypads used to send DTMF signals to the computer; 4) perform voice communication with the computer; and 5) ring upon a command from the computer (e.g. Wakeup service). The

adapter can be also connected to the telephone line, thus connecting the telephone and/or the computer to the line. Optionally, the speakers and the microphone can be connected to the adapter, and activated whenever required by the user, through a mechanical switch on the adapter.

The present invention provides a low cost, high quality solution to the computer audio problem listed above. Among other attributes, the PhoneConnect adapter and related architecture improve the audio quality by reducing feedback from the system; allow the use of a plurality of phones as peripheral input/output devices to a computer; and allow remote phones to act as input/output devices to a computer. PhoneConnect further improves the user experience by automatically determining if the audio signal should be routed to the computer audio peripherals or the telephone.

The principles and operation of a PhoneConnect adapter according to the present invention may be better understood with reference to the drawings and the accompanying description.

Referring now to the drawings, FIG. 1 illustrates a basic embodiment of a system **10** that includes one or more telephones **12** electrically connected (in "data communication") through a PhoneConnect configurable adapter **14** to a computer **16**. Preferably, telephone **12** is a regular (wired or wireless) telephone of the type used with PSTN lines. Adapter **14** can be a separate (stand-alone) unit, as shown in FIG. 1, or it can be implemented in a modem or audio card of computer **16**. Adapter **14** is using analog signals with both telephone **12** and computer **16**, and can be configured to operate in different operating modes, for different purposes, as explained in detail below.

In the basic mode, there is analog signal transfer between telephone **12** and computer **16**, facilitated by adapter **14**. This entirely analog transfer is essentially

different from that provided by the system of Shahar in WO9839897A1, as exemplified by his Figure 1, where the adapter-telephone connection is analog, but the adapter-computer connection is digital. Adapter **14** is preferably powered by a power supply **15** that gets its power from internal battery **124** (see FIG. 3) from an external power input **33** (see FIG. 4), from computer **16** through one of its ports **189** (see FIG. 4), or from the PSTN line.

FIG. 2 shows a preferred embodiment of adapter **14** that enables the system to operate in and switch between the different operation modes. Adapter **14** includes an Anti Feedback Network (AFN) **20** (sometimes called "Hybrid") having an AFN input **22** and an AFN output **24.** The AFN is a well-known element in telephony systems. In the present invention, is fulfils (among others) the role of detector of ON/OFF-HOOK states of the telephone. For example, when the telephone is in ON-HOOK, its impedance does not generally match that of the AFN, and the AFN will not prevent feedback, thus allowing the detection of this state by sensing the signal level at an adapter output **48** while applying signal to an adapter input **50**.

Typically, the adapter is electrically connected by various connecting means to the computer peripherals (external microphone and speakers) via an external microphone jack **26** and an external speaker jack **28,** to the PSTN line through a line jack **30**, and to the telephone through a phone jack **32**. The connections can be made through two-state switches SW, marked SW1 **(40)**, SW2 **(42)**, SW3 **(44)** and SW4 **(46)**. In the following, all switches in this specification are included under the definition of "switching means". As well-known to one versed in the art, switching may be done by different types of switches, including electromechanical, electrical and semiconductor, all of which may be used for the purposes of the present invention. All switches have preferably two states, 'A' and 'B'. In "state A", the

adapter enables the use of the telephone as an input/output device to the computer and uses a buzzer **47** to indicate an incoming call at the PSTN line, while disabling the external speakers and microphone. In "state B", the adapter enables the use of the telephone as a regular telephone, and enables the use of the external speakers and microphone with the computer.

The following illustrates, in a manner of example only, the operation of the system in states A and B. In state A, AFN output **24** is connected to adapter output **48** (which includes lines "tip", "ring 0" and ring 1") via switch SW2 **42**. AFN input **22** is connected to an adapter input **50**. The AFN performs two main tasks: a) it supplies working power to the telephone; and b) it directs electrical signals from its input **22** to the telephone, but attenuates these signals at output **24**, while allowing signals from the telephone to pass to output **24**. The external speakers are disconnected by switch **40**.

In state B, the telephone is connected to the PSTN line via switch SW3 **44**. In this state, switches SW1 **40** and SW2 **42** connect speakers **28** and microphone **26** to the computer. The microphone power ("ring 1" of **48**) from the audio card is connected directly to the microphone jack **26**, to supply power to the external microphone.

Transfer of information and control commands between the computer and the adapter can extend the functionality of the adapter. This transfer can be implemented in a number of ways (hereafter referred to as employing the "data communication" methods). Examples of such information and control commands from the adapter to the computer include telephone OFF-HOOK state, caller ID, incoming call from PSTN line input, or DTMF data. Examples of such commands from the computer to the adapter include Mode control, Ring command or speaker Mute. The data

communication between the computer and the adapter can be carried out in a number of ways. In the embodiment of FIG. 3, it is carried out via cables **102, 104** connected to the audio input/output of the audio (sound) card.

Referring now to FIG. 3, the figure shows a schematic diagram of a more detailed embodiment of the system of the present invention. The connection between the adapter and the computer is typically done through a sound (audio) card **100** in computer **16** via cables **102** and **104**. Cable **102** represents the "audio in" and is connected to the audio input of card **100.** Cable **104** represents the "audio out" and is connected to the audio output of card **100**. In the embodiment of FIG. 3, adapter **14** is, as in FIG. 1, a separate (stand-alone) unit. However, adapter **14** may be implemented in a modem in computer **16**, or implemented as part of card **100**. FIG. 3 shows adapter **14** connected electrically to one or more external speakers **106**, and to an external microphone **108** (matching the connections to jacks **28, 26** respectively in FIG. 2). Card **100**, being electrically connected to adapter **14**, can also be connected and disconnected from peripheral components **106, 108**, as discussed below. In this embodiment, adapter **14** includes a manual switch **140** used to set operation modes. Adapter **14** typically includes a signal generator/detector **120**, and optionally, a Hook-Off detector and ringer **122**, and an internal power source (e.g. battery) **124**. In addition, the adapter may include a control logic module **130.** Signal generator/detector **120** is preferably programmed to generate a predefined audio signal for each input from control logic **130**, and to activate a certain output to the control logic of the adapter upon detecting predefined audio signals. The audio signals can be for example the A, B, C, D tones of the DTMF standard, in which case the signal generator/detector will be a DTMF transceiver, or signals of any other predefined standard.

FIG. 3 also shows in computer **16**, a control software **150**, which serves as a driver or a service program for the adapter, and other (user application) software **152**. Control software **150** may implement a DTMF decoder **154**, which receives its input from audio card **100**. Alternatively, a DTMF decoder **198** (FIG. 4) may be implemented in adapter **14**. Control software **150** can implement a signal generator/detector in software with the predefined audio signals of the adapter. The purpose of this implementation is to detect and control the modes of operation of the PhoneConnect adapter, and to supply this ability (or service) to control software **152**, as explained in more detail below. User application **152** is also in data communication with the audio card.

Using an OFF-HOOK event as an example, signal generator **120** generates a predefined audio signal for this event, and sends this signal to audio card **100** via audio in cable **104**. The signal is digitized (A/D conversion) in card **100**, and sent in converted digital form as an input to control software **150**. The control software detects the predefined signal and sets a flag that can be read by user application **152**. For example, when the telephone changes to OFF-HOOK, control logic **130** in adapter **14** sends a DTMF signal 'A' to the microphone via line **102** of the audio in of audio card **100**. Control software **150** receives the digital data from the audio card, processes these data and detects the DTMF 'A' signal, then sends a message to user application **152** to start recording audio from the telephone.

Referring now to both FIGS. 2 and 3, in a first basic mode of operation ("mode 1"), telephone **12** is used as a regular telephone to place or receive calls, and connected electrically to a PSTN (wall) line. The external speakers and/or the microphone are in this mode connected electrically to audio card **100** of computer **16** through adapter **14**.

In a second basic mode of operation ("mode 2"), telephone **12** is used as an audio input/output device to computer **16**. In this mode, speakers **106** and microphone **108** are disconnected electrically from card **100**.

In a third mode of operation ("mode 3"), more detailed below, telephone **12** is used as in the second mode, but external speakers **106** are connected to card **100**, in order to hear the audio signals externally.

A switching or change between the basic operation modes can be effected in a number of ways: a) by the user, who changes the state of an electromechanical switch or pushbutton on adapter **14**; b) by the user, who presses a special code (for example ##*) on the telephone keypad; c) automatically, when receiving a regular or Internet call; d) automatically, when detecting a power loss at the power supply of adapter **14** (adapter goes to mode 1) or when detecting a power loss at the PSTN line jack input (adapter goes to mode 2); and e) by a command from the computer.

FIG. 4 shows a schematic embodiment of the system in which commands are transferred (i.e. the data communication of commands is carried out) between telephone and computer via another digital port of the computer. The port in question may be for an example RS232, MIDI, GAME, USB, LPT or Infra Red port. This embodiment includes in addition a Ring and PSTN line Power Detector **180** that can be operated by an isolated power supply **184**. Power detector **180** sends its output to control logic **130** via an isolation part **182** (e.g. an opto-coupler). The isolation is needed because the PSTN line voltage level is not the same as the adapter and computer ground voltage levels. Also added are a first sum mixer **186**, which can be implemented with a resistor network of two resistors, and which combines the L & R stereo signals to a single line for the AFN input. A control port **60**, which is connected to a digital port of the computer, transfers commands between control logic **130** of the

adapter and the computer. Additionally control port **60** can supply power to the adapter power supply **15** via a power line **189**. Drivers **188** are appropriate voltage level translators, inserted if necessary between control logic **130** and the digital port of the computer. Upon a command from the control logic, Hook-Off detector and Ringer **122** can generate a high voltage ring signal to the telephone, so that the phone's internal ringer rings like a PSTN incoming ring. The above ring signal is transferred to the telephone via SW3 and phone jack **32**. When the user picks up the phone, a Hook-Off state will be detected by Hook-Off detector and Ringer **122,** which sends a Hook-Off signal to control logic **130**. Hook-Off detector and Ringer **122** allows a clear path for all audio signals between the AFN and the telephone. A "Phone" pushbutton **194** and a "Computer" pushbutton **196** can change the modes of the adapter, to modes 1 and 2 respectively. A "Phone" LED **190** and a "Computer" LED **192** can indicate the appropriate mode. A DTMF decoder **198** is receiving its input from the AFN output via a second sum mixer **199**, so that it can decode DTMF key press signals from the telephone while in mode 2. DTMF decoder **198** also receives input from the PSTN line via sum mixer **199** and an isolated PSTN signal line **183** through an isolation part **182**. Thus, the DTMF decoder can decode DTMF key press signals from the telephone while the adapter is in mode 1. The decoded DTMF signal is sent to control logic **130,** which can be implemented for example by a micro-controller. In addition, control logic **130** can send an audio signal to the telephone via a "Beep line" **185,** and via a third sum mixer **187** to the AFN input (e.g. to indicate an incoming PSTN call in mode 2). Switches SW1, SW2 and SW3 are controlled by control logic **130**.

Automatic mode change

As mentioned above, the adapter can change between modes automatically when it detects a PSTN line power loss. In a preferred embodiment, the adapter's PSTN line jack **30** can be connected to a modem telephone jack (not shown), and the modem's line jack can be connected to the PSTN line. When the modem is using the PSTN line, e.g. for Internet connection, the modem's telephone jack is usually disconnected from the PSTN line and no voltage is present. The adapter's control logic **130** can detect this power loss by power detector **180**, and use it to change mode automatically from mode 1 (telephone **12** connected to the PSTN line jack) to mode 2, so that telephone **12**, which is connected to the adapter's phone jack **32**, is now connected to the computer for input/output. However, the external speakers are connected to the computer until the user picks up the telephone handset, and until an Off-Hook state is detected by Off-Hook detector **122**. When power detector **180** detects line power, the control logic changes the mode to mode 1. The mode change can take effect only when the user lies the handset on the telephone, and an On-Hook state is detected by detector **122** ("not Off-Hook" is On-Hook in mode 2) This ensures that if the user is still using the telephone with the computer (mode 2) when the modem stops using the PSTN line, the telephone will not be disconnected from the computer suddenly.

Indicating an incoming PSTN call in mode 2

While the adapter is in mode 2, if a PSTN call arrives, power detector **180** detects the ring signal of the PSTN line and sends an indication to control logic **130**.

The control logic can then send a beep signal to the telephone via beep line **185**. In addition, the control logic can cause phone LED **190** to blink.

Simplified command data communication

The data communication may also be carried out by the adapter through the use of one or more input/output pins on one of the ports above as a one-bit digital port. In this case, the data transfer can be implemented by simpler and/or cheaper hardware.

The system of the present invention can use a "Call Waiting" indication, whether of a regular call (from the PSTN line) while the telephone is connected to the computer, or of an Internet call indication while the telephone is connected to the PSTN line. That is, the "Call Waiting" indication can be used for example, to receive a PSTN call while in mode 2, or an Internet call when in mode 1. To indicate an incoming call from the PSTN line while in mode 2, as explained above, the adapter would preferably utilize power detector **180** with one of the data communication methods above. Typical actions to indicate Call Waiting may include: blinking of phone LED **190** or a computer LED **192**, buzzing of a built-in buzzer, an electric signal being sent to the external speaker, and audio signal being sent to the telephone, or the ring detection signal being sent to the computer, to be viewed as a visual alarm on the computers video monitor. While receiving an Internet call with the PhoneConnect in mode 1, the adapter may typically receive a signal from the computer utilizing the "data communication" method, and respond with one or more of the above listed Call Waiting indications. If the telephone is not in use, the adapter can utilize high voltage (HV) ringer **122** to send an HV ring signal to the telephone and activate its ringer

Extended Modes

Fig 5 shows possible alterations of the PhoneConnect adapter to include additional modes. In addition to modes 1 and 2 described above, this embodiment includes: mode 3 - connecting the PSTN line as an input/output device to the computer, and mode 4 - connecting both the PSTN line and the telephone together as an input/output device to the computer. Fig 5 shows only the necessary parts needed to explain this embodiment. Also shown in Fig 5 is a table of switch settings **250** for each mode An isolation **202** is used to isolate the PSTN line in modes 1, 3 and 4 from the computer side voltages (AFN). Isolation **202** is connected to a Hold circuit **204** that provides a dc hold current and impedance match for the PSTN line. The Hold circuit and switches are activated by the control logic. The Hold circuit is connected to SW3 that can disconnect Isolation **202** and Hold circuit **204** from PSTN line **30** in mode 1. SW2 is connected between the telephone and SW3, and it can be used to disconnect the telephone in mode 3. SW1 is connected between SW3 and PSTN line **30**, and it can be used to disconnect the PSTN line in mode 2. In addition, in mode 2, SW1 is connecting a Non-Isolated Power + Ring (generator) **206**. SW1 enables the use of a non-isolated power to the telephone because it disconnects at the same time PSTN line **30** from the telephone. Detector **180** and a Caller I.D circuit **200** send their output to the control logic via isolation part **182** (see FIG. 4). The DTMF signals of the telephone and from the PSTN line can be detected in the appropriate modes by DTMF decoder **198** receiving its input from the output **24** of the AFN **20** (see FIG. 4).

The embodiment described in Fig. 5 is preferably implemented in a modem in the computer. Other embodiments relate to the implementation of the adapter as part of the audio card. For example, part or all of the adapter components can be added to

the audio card or modem. If all the necessary adapter functions are added to the audio card, there is of course no need for a separate, stand-alone adapter. However, a stand-alone adapter may still be preferable in terms of versatility and cost-effectiveness.

Additional and optional features may be added to the Phone Connect adapter. These include:

a. DTMF control via the PC, to switch between the microphone and the speakers. This option allows the user to bypass the manual selection of the phone/audio peripherals (microphone and speakers) as described in the mode switching operations above.

b. Keyboard control. The phone keyboard can be used to transmit the DTMF signals that control the adapter operation mode, i.e. the toggling between the telephone and the audio peripherals.

c. A ringer that will ring via the phone once a voice-over IP call arrives to the computer.

d. A buzzer inside the adapter (e.g. buzzer 47 in FIG. 2).

e. Software DTMF detection and analysis components added to the computer, each DTMF sequence activating a different function through the software.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.